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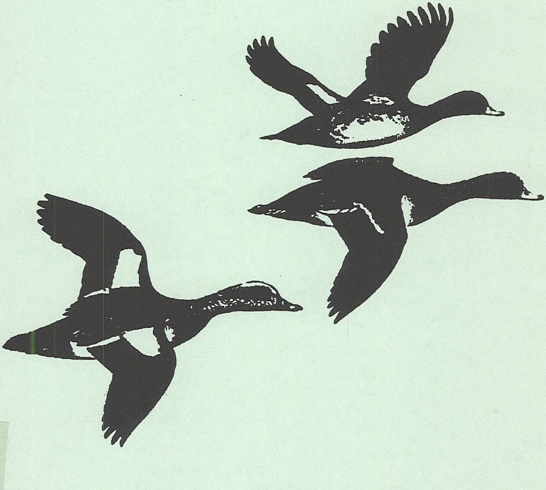
Ground Brood Counts to Estimate Waterfowl Populations in BLM's Kobuk District, Alaska: 1990 Progress Report

Randi R. Anderson and Scott R. Robinson



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Ground Brood Counts to Estimate Waterfowl Populations in BLM's Kobuk District, Alaska: 1990 Progress Report

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Abstract

Between July 16 and 27, 1990, duck brood surveys were conducted on the Pah River Flats in interior Alaska and McCarthys Marsh on the Seward Peninsula. The Pah River Flats was included as part of a larger survey by the U.S. Fish and Wildlife Service, Koyukuk/ Nowitna National Wildlife Refuge. Twelve plots, each 2.6 km^2 in size on the Seward Peninsula were surveyed, using a random stratified sampling technique. Observed production on McCarthys Marsh was 8.35 young/km^2 in 1990 compared to 5.22 young/km^2 in 1989. Observed production of young differed significantly ($P < .005$) between the two survey years.

Introduction

Alaska's public wetlands are becoming an increasingly valuable resource as continental waterfowl breeding habitat diminishes because of development, drought, and pollution. In 1989, it was estimated that Alaska hosted 60% of the breeding population of pintails (*Anas acuta*) (R. Posahala, pers. commun.) Inventories will help identify important waterfowl habitat on Bureau of Land Management (BLM) land in the Kobuk District. Such baseline data is essential to determine the impacts of settlement, oil and gas leasing, and mineral exploration and development (BLM 1983, 1986).

King and Lensink (1971) estimated a breeding population of 60 ducks per square mile (155.4/km^2) of waterfowl habitat on the Seward Peninsula. Prior to our study, intensive brood inventories had not been conducted on the Seward Peninsula. Ground brood survey counts have been conducted by the U.S. Fish and Wildlife Service (FWS) on other wetland areas in interior and northwestern Alaska. The staff of the Selawik National Wildlife Refuge has inventoried waterfowl on their refuge annually since 1986 (Brubaker and Witmer 1989), as has the Koyukuk National Wildlife Refuge (Rost and Bertram 1989). They have attempted to estimate waterfowl production based on the number and size of broods counted by observers on the ground. Our study follows their methodology closely in order to obtain the most meaningful comparison of wetland habitat value and productivity.

We thank M. Bertram (Koyukuk/Nowitna National Wildlife Refuge) for field assistance, and R. Brubaker (Selawik National Wildlife Refuge) for technical assistance in preparing the study. H. Brownell and N. Messenger of

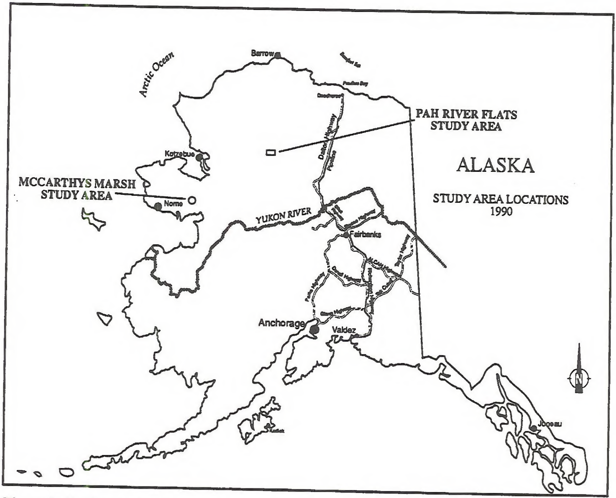

Figure 1. Study area locations.

BLM's Kobuk District helped with fieldwork, and pilots C. Conkle (Wright's Air) and J. Collins (Windy's Mag Air) provided safe and efficient transportation.

Study Areas

The Pah River Flats, located in north-central Alaska between the Kobuk and the Koyukuk rivers, is a basin covering about 728 km^2 (Fig. 1). The Pah River flows from the northwest corner of the study area to the south and then to the northeast corner in a wide arc. The lowlands include numerous lakes, ponds, marshes, and streams. Individual lakes are less than 0.60 km^2 in size. The vegetation types include treeless marshes, sedge meadows, open spruce forests, closed spruce forests, low shrub, high shrub, and alpine tundra. Most of the ponds support a border of emergent vegetation characterized by sedges (*Carex*), buckbean (*Menyanthes trifoliata*), marsh fivefinger (*Potentilla palustris*), and water hemlock *Cicuta mackenzieana*). On average, about 10% of the water surface is covered by floating or aquatic species. Chief among these are yellow pond lily (*Nuphar polysepalum*), dwarf pond lily (*Nymphaea tetragona*), bur reed (*Sparganium*), scouring rush (*Equisetum*), pondweeds (*Potamogeton*), and bladderwort (*Utricularia vulgaris*).

McCarthys Marsh lies just south of the Bendeleben Mountains, in the neck of the Seward Peninsula. Norton Bay is about 40 km to the south. The basin containing McCarthys Marsh is drained by the Fish River and its tributaries. This study area also includes Death Valley, a small valley which lies east of McCarthys Marsh, across the Darby Mountains. McCarthys Marsh is a pond-covered valley about 520 km^2 in size and Death Valley, drained by the Tubutulik River, is about 182 km^2 in size. The major vegetation types in the study area are herbaceous, dominated by sedges (*Carex* spp.), cottongrass (*Eriophorum* spp.), lichen mat, and low shrub communities. Areas of mixed hardwood and coniferous forest are mainly in riparian zones. Many of the larger lakes have drained or dried considerably since 1956, based on U.S. Geological Survey topographic maps. These shallow lakes are lush with emergent vegetation, mainly grasses and sedges, 0.5 m in height. Other lakes, many of them of thermokarst origin, have abrupt borders with the surrounding tussock tundra and ericaceous shrub communities. Some of the key species in these communities are Labrador tea (*Ledum palustre*), dwarf birch (*Betula nana*), blueberry (*Vaccinium uliginosum*), crowberry (*Empetrum nigrum*), cloudberry (*Rubus chamaemorus*), cassandra (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia*), willow (*Salix*), and alder (*Alnus crispa*).

Methods

In Anderson and Robinson (1991) we describe the methods of habitat delineation, stratification, and survey techniques used in 1989. In 1990, the same techniques were used, except that "moderate" and "key" strata were combined into a single stratum called "other," in keeping with recommendations by FWS to standardize brood surveys (FWS 1990). Each section identified as potential waterfowl habitat was assigned a number. Plots to be surveyed were then selected using a random numbers table. A random numbers table was used to determine the priority of sample plot selection. A greater proportion of plots in the "other" production stratum than of the "poor" stratum was sampled to reduce the variance of the stratified mean broods per plot (McDonald et al. 1989). An average number of young of all species per plot was calculated for each stratum. The product of the average young per plot and the number of plots in the stratum estimated total young produced in each stratum. These were summed to give an estimate of total duck production for each study area. For production estimates, four young were included for each broody hen seen, rounding to the nearest whole number (Rost 1988). Standard errors of the sample means were computed according to Cochran's (1977) formulae for stratified random samples, which use the finite population correction factor $(N - n)/N$, where N is the population size and n is the sample size. Differences between brood densities for the two years were compared using a Student's t-test.

Access to plots was by floatplane. Observers paddled around the waterbodies in canoes or walked around the margins. When it was necessary to land on a lake within the plot, that lake was surveyed last to allow time for waterfowl behavior to return to normal. All waterbodies lying within or mostly within the plot were surveyed in entirety. Waterbodies were defined to lie within the plot if their centers were included within the plot. While conducting the survey we gave priority to counting duck broods, but we also attempted to identify and count all waterfowl seen. Birds were observed with the aid of binoculars or spotting scope, and recorded by species, age class, and number of young. Duck broods were classified as age class I, II, or III according to Bellrose (1976).

Key vegetation (aquatic, emergent, and shoreline) was recorded for at least one water body on each plot, and samples were collected for identification. On some lakes, water temperature was measured, depth and transparency estimated using a Secchi disk, and water hardness and pH determined using a Hach water chemistry kit.

Results

McCarthys Marsh has approximately 400 km² of waterfowl habitat, with 150 km² in the "other" stratum and 250 km² classified as "poor." Twelve plots of 2.6 km² each were surveyed. A field crew of four people counted 85 duck broods, 14 adult tundra swans (*Cygnus columbianus*) with 3 young, 27 red-necked grebes (*Podiceps grisegena*) with 5 young, 11 arctic loons (*Gavia arctica*) and 5 common loons (*G. immer*). Eight adult and 12 young Canada geese (*Branta canadensis*) were observed. Table 1 displays results for number of young and broods per plot by stratum with their respective standard errors. In the "other" stratum, 16.9 young/km² were produced and in the "poor" stratum 3.2

Table 1. Estimated duck production for McCarthys Marsh, Alaska, 1990.

	Stratum			
	Other	Poor	Total	
Plots surveyed (n)	9	3	12	
Observed young	329	17	346	
Broody hens	16	2	18	
Broods*	80	5	85	
Broods*/plot	8.89	1.67	4.39	
SE (broods)	2.755	1.641	1.460	
Young**/plot	43.67	8.33	21.6	
SE (young)	16.50	8.20	8.05	

*includes broody hens.
**broody hens assigned 4 young each.

Table 2. Estimated duck production for McCarthys Marsh, Alaska, 1989[1].

	Stratum			
	Key	Moderate	Poor	Total
Plots surveyed (n)	5	4	4	13
Observed young	189	10	19	218
Broody hens	23	13	0	36
Broods*	73	18	5	96
Broods*/plot	14.60	4.50	1.25	3.65
SE (broods)	5.538	2.584	0.616	1.008
Young**/plot	56.2	15.5	4.8	13.6
SE (young)	22.175	9.202	2.508	3.856

*includes broody hens.
**broody hens assigned 4 young each.
[1] Anderson and Robinson 1991

young/km² were produced. The stratified mean was 8.35 young/km². The total number of broods produced on McCarthys Marsh was estimated to be 676 ± 220 broods (CV = 33%). The estimate for duck production in McCarthys Marsh was 3332 ± 1237 young (CV = 37%).

The average duck brood size across species was 4.4 ± 2.1 for class III broods and 4.8 ± 2.4 for class II broods (Table 3). The average brood size overall was 4.6 ± 2.2. Of 62 dabbler brood observations, 18 (29%) were broody hens without observed young. The remaining dabbler broods had an average overall brood size of 4.1 (n = 44), compared to 5.5 (n = 21) for the diver broods.

Table 4 shows the species composition of 171 adult ducks surveyed in 1990 along with 1989 data on 407 adults. The dabbler to diver ratio was 83:53, or 61% dabblers. Species composition of broods is illustrated for both years in Figures 2 and 3. Pintails comprised 28% of the the dabbler broods observed in 1989 (Anderson and Robinson, 1991) and 40% in 1990 (including gang broods).

From the habitat surveys (n = 14), the most frequently reported emergent plants were *Eriophorum*, *Hippuris vulgaris*, *Beckmannia*, *Carex* and *Potentilla palustris*. Among the aquatic, floating, or semi-submerged plants, *Sparganium*, *Nymphaea tetragona*, *Utricularia*, and *Menyanthes trifoliata* were most frequently reported. Limnological characteristics of the McCarthys Marsh waterbodies (n = 3) included temperatures of 15° to 17° C, pH 6.5 to 6.9, Secchi transparency 75 to 135 cm, and total hardness of 17 to 51 mg/l $CaCO_3$.

Discussion

Production on McCarthys Marsh in 1990 was greater than in 1989 (t = 3.18, P < 0.005), as can be seen by comparing Tables 1 and 2. However, there was no significant difference in the number of broods at the 95% confidence level. This may be due to the occurence of gang broods containing up to 24 young in 1990. Gang broods are characteristic of late class II and class III young. Due to an early spring on the Seward Peninsula, the age

Table 3. Duck brood summary for McCarthys Marsh, Alaska, 1990.

Broods:	Class I		Class II		Class III		Broody hens	Total broods	Avg. size
Species	No.	Avg. size	No.	Avg. size	No.	Avg. size			
Dabblers									
Mallard	0	-	2	3.0	6	4.5	5	13	4.1
Wigeon	0	-	7	3.3	3	4.7	1	11	3.7
G.w.teal	0	-	3	4.0	1	11.0	2	6	5.8
Shoveler	0	-	3	4.0	1	5.0	0	4	4.2
Pintail	0	-	3	4.7	11	3.5	10	24	3.8
Unknown	0	-	0	-	4	4.8	0	4	4.8
Subtotal	0	-	18	3.7	26	4.4	18	62	4.1
Divers and Seaducks									
Scaup	0	-	1	6.0	2	5.0	0	3	5.3
Scoters	1	6.0	9	6.8	2	5.0	0	12	6.4
Oldsquaw	0	-	2	4.5	1	6.0	0	3	5.0
Unknown	0	-	0	-	3	2.7	0	3	2.7
Subtotal	1	6.0	12	6.3	8	4.2	0	21	5.5
Total:	**1**	**6.0**	**30**	**4.8**	**34**	**4.4**	**18**	**83**	**4.6**

Note: Gang broods excluded from all figures in this table.

of broods was more advanced in July 1990 than it was during July 1989.

The average size of broods was significantly greater in 1990 than in 1989, by about one duck per brood (t = 2.65, P < .005). The reasons for this are not clear. It is possible that the more favorable environmental conditions early in the brood-raising period enhanced the survival of young. In addition, females allowed to start nesting early may have had greater energy reserves, enabling them to produce larger clutches.

Pintails comprised about 40% of the dabbler brood observations in 1990, with more than twice as many as any other dabbler species (Table 3). Yet pintails have the earliest mean hatching date—about two weeks earlier than mallards—so that their numbers may be underestimated when surveys are conducted late. Rost (1988) gives the mean hatching date for pintails on the Koyukuk National Wildlife Refuge as June 6. Since the young may be capable of flight in six weeks (Bellrose 1976), a late July survey might be expected to miss many broods. Thus, it is likely that the number of pintails produced on McCarthys Marsh in 1990 considerably exceeded our estimate.

The mean number of young ducks produced on the Pah River flats in 1989 was 2.12/km^2, significantly less than the mean of 5.22/km^2 produced on McCarthys Marsh in 1989 (t = 6.325, P < 0.0005). The mean number of

Table 4. Species composition of adult ducks counted during brood surveys for McCarthys Marsh, Alaska, 1989 and 1990.

Common name	Scientific name	1990		1989[1]	
		Adults	%	Adults	%
Mallard	*Anas platyrhynchos*	21	12	21	5
American wigeon	*Anas americana*	11	6	91	22
Am. green-winged teal	*Anas crecca carolinensis*	19	11	47	12
Northern shoveler	*Anas clypeata*	5	3	26	6
Northern pintail	*Anas acuta*	27	16	115	28
Scaup spp.	*Aythya* spp.	7	4	41	10
Bufflehead	*Bucephala albeola*	0	0	3	1
Black scoter	*Melanitta nigra americana*	31	18	10	2
Surf scoter	*Melanitta perspicillata*	2	1	3	1
White-winged scoter	*Melanitta fusca deglandi*	3	2	3	1
Oldsquaw	*Clangula hyemalis*	10	6	102	
Unidentified		35	20	37	9
Total		**171**	**100**	**407**	**100**

[1] Anderson and Robinson 1991

broods also differed significantly between survey areas ($t = 6.935$, $P < 0.0005$). These results indicate that the Seward Peninsula habitat supported higher production per unit area for 1989 (Anderson and Robinson 1991). A comparision between the same areas is not available for 1990 because the Pah River Flats was incorporated into a larger survey. The BLM's Kobuk District participated in that survey, conducted by the FWS Koyukuk/Nowitna National Wildlife Refuge, by providing a field technician for one week.

There were numerous observations of "broody" hens. A broody hen is a single hen exhibiting aggressive or decoy behavior but no brood is seen. For computations, we assumed all such hens had a hidden brood of four young. Ideally, the brood size assigned to broody hens should be the average size observed in a specific locale and year for the particular species. However, in a small study, average brood sizes are subject to wide variation and may not be representative (see Results). Also, the brood size is highly dependent on the age of the brood, as mortality is much higher early in brood-rearing. The amount of error introduced by our treatment of broody hen observations is unknown. The percentage of broody hens as a component of overall brood observations at McCarthys Marsh fell from 37.5% in 1989 to 21.2% in 1990. A small canoe was used for the 1990 survey, and this may have improved surveyors' chances of detecting broods in areas with lush vegetation. The reasons for large numbers of broody hen observations might include cover type, time of day, weather influences, or experience of the observers.

One of the biggest challenges in surveying waterfowl broods is the high variability among samples, which lowers the precision of population estimates. An increase in the coefficient of variation from 27% to 33% of broods in McCarthys Marsh from 1989 to 1990 is probably due to the use of two rather than three strata. This increase is more likely to be an artifact of the survey design rather than a real difference in the data. The stated goal of FWS (1990) for brood surveys in Alaska is a 15% coefficient of

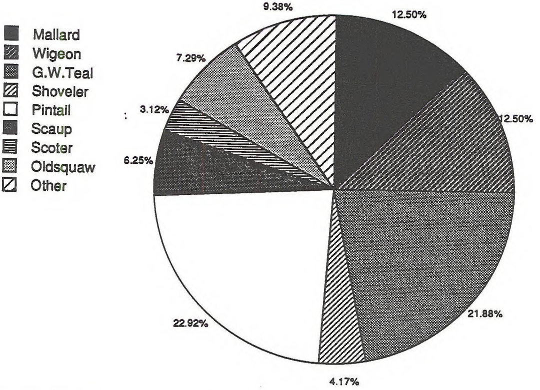

Figure 2. Species composition of broods, McCarthys Marsh, Alaska, 1989.

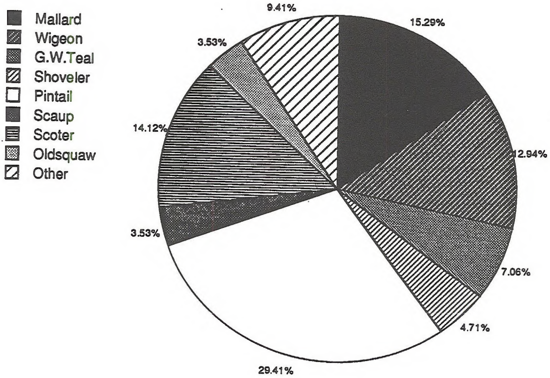

Figure 3. Species composition of broods, McCarthys Marsh, Alaska, 1990.

variation. Expanding the study area and the number of samples is the preferred method to reduce variance as it increases both the quantity and quality of information; however, it also increases the cost. The Kobuk District plans to expand its waterfowl survey into the Kuzitrin River basin in 1991. We accomplished an exploratory flyover and determined accessibility during the 1990 field season.

Because the observed variability within strata defined from topographic maps was high, we feel that alternative methods for stratification should be investigated. Numbers of broods on "other" plots in 1990 ranged from 0 to 31, while "poor" plots ranged from 0 to 3. Observed ground features, including the number and size of ponds, varied considerably from the topographic maps, particularly on the McCarthys Marsh, for which the most recent maps were made in 1952. Evidently, this is an area where the hydrologic regime is in a state of rapid flux, as there were marked changes even from the high altitude aerial photographs taken in 1981.

The data on vegetation and limnologic characters from McCarthys Marsh in 1990 was descriptive, as it was not systematically collected. Further study is needed to determine the possible connection between these characteristics and waterfowl production. If limnological parameters can be quantitatively linked to production, it may be possible to measure some of them using remote sensing techniques. This would be a breakthrough for land managers, as it would allow large areas of habitat to be inventoried with a reduction in the cost-prohibitive field work presently required. The FWS and BLM's Anchorage District are actively conducting research in this field (Seppi 1990).

Determining the effect of fire on waterfowl habitat quality is a long-range goal of the waterfowl studies conducted by BLM's Kobuk District. Plots located within an old burn area were compared with similar plots outside the burn (Table 5). Fire no. 8633 burned 46,000 acres in 1977, and the fire perimeter is clearly visible on high-altitude aerial photographs taken in 1981. Only plots meeting the criteria for "moderate" habitat (Anderson and Robinson 1991) were used for comparison. The selected plots had between 2 and 12 waterbodies each covering 9.4 to 15.6% of the surface area. Using a Student's *t*-test, no significant difference between the production of burned and unburned plots was found at the 95% confidence level. At the 90% confidence level, only the total waterfowl observed differed significantly ($t = 1.977, P < 0.1$)being less in burned ($n = 3$) than in unburned ($n = 7$) plots. These findings are interesting, though not conclusive, evidence of the relationship between fire and habitat use. It may be that the height of vegetation is directly linked to the quality of cover. In the arctic climate of the Seward Peninsula, vegetation grows very slowly following disturbance. More study will be necessary to understand the role of fire in subarctic wetlands.

In considering the population estimates derived from this type of brood survey, we must keep in mind several limitations. There is no consideration for young raised before or after the date of survey nor for mortality of observed young. Furthermore, sightability is assumed to be 100%, although we know that it is considerably less on some plots. Such factors as wind, time of day, vegetation type, the observers' experience, and cloud cover all affect sightability. In 1989, more broods were observed during standard surveys than during sightability surveys on 24 waterbodies. This unexpected result was attributed to broods going undetected in thick stands of emergent vegetation (Bertram 1990). Improved techniques were employed in 1991, but results were not yet available (Bertram pers. commun.) at the time of this publication.

Inventories are perhaps the single most important waterfowl management tool available to BLM-Alaska at present. It appears that the study areas both support nesting densities comparable to those on nearby refuges and that a significant num-

Table 5. Waterfowl observed in burned vs. unburned plots in McCarthys Marsh, Alaska.

PLOT	YEAR	LEGAL LOCATION	1977 BURN	BROODS	TOTAL*
M-2	1989	T21W R5S 08	YES	0	8
O-2	1990	T21W R5S 08	YES	2	10
O-9	1990	T21W R5S 11	YES	6	29
M-1	1989	T22W R5S 28	NO	5	24
O-1	1990	T22W R5S 28	NO	5	49
M-3	1989	T22W R5S 14	NO	12	75
O-3	1990	T22W R5S 14	NO	9	53
M-4	1989	T22W R5S 36	NO	1	13
O-8	1990	T21W R5S 32	NO	13	78
O-11	1990	R5S T23W 02	NO	5	31

* Total young and adult ducks observed

ber of pintails are produced on the open tundra of the Seward Peninsula. Baseline data on breeding grounds, including production and habitat characteristics, are essential to determine the effects of resource development such as mining, grazing, and oil exploration, as well as to understand the effects of natural phenomena such as flooding and fire. Because waterfowl breeding populations are highly variable, surveys must be carefully designed so they can be accomplished efficiently and economically.

Literature Cited

Anderson, R. R. and S. R. Robinson. 1991 (in press). Ground brood counts to estimate waterfowl populations on two habitats in western Alaska. The Wildlife Society: Proc. of the Western and Northwestern Sections Meeting in Reno, NV, Feb. 22-24, 1990.

Bellrose, F. C. 1976. Ducks, geese, and swans of North America, second ed. Stackpole Books, Harrisburg, PA. 543pp.

Bertram, M. 1990. Wetland ecology and sightability correction for waterfowl productivity surveys on the Koyukuk National Wildlife Refuge. USDI, Fish and Wildl. Service, Koyukuk/Nowitna NWR, Galena, AK. 23 pp.

Brubaker, R. A., and D. E. Witmer. 1989. Review of waterfowl inventory surveys at Selawik National Wildlife Refuge, 1985-1988, and proposed changes for future surveys (draft). Progress Report SNWR 89-1, USDI, Fish and Wildl. Service, Selawik NWR, Kotzebue, AK. 15pp.

Bureau of Land Management. 1983. Seward 1008 study decision record. USDI, Bur. Land Manage., Fairbanks, AK. 15pp.

———. 1986. Resource management plan and record of decision for the Central Yukon Planning Area. BLM-AK-PT-86-031-1610-026. USDI, Bur. Land Manage., Fairbanks, AK. 66pp.

Cochran, W. G. 1977. Sampling techniques. Third ed. John Wiley & Sons, Inc., New York, NY, 428pp.

Fish and Wildlife Service. 1990. Draft duck production survey standard operating procedures manual. USDI, Fish and Wildl. Service, Anchorage, AK. 63pp.

King, J. G. and C. J. Lensink. 1971. An evaluation of Alaskan habitat for migratory birds. Admin. Rep., U.S. Bureau Sport Fish and Wildl., Washington, DC. 46pp.

McDonald, L. L., H. B. Harvey, and T. J. Novotny. 1989. Recommendations for refinement of duck brood surveys for the Alaska region of the U.S. Fish and Wildlife Service. Depts. of Statistics and Zoology, Univ. of Wyoming, Laramie. 25pp.

Rost, G., 1988. Koyukuk National Wildlife Refuge 1987 duck brood survey (draft). USDI, Fish and Wildl. Service, Koyukuk NWR, Galena, AK. 13pp.

Rost, G., and M. Bertram. 1989. Koyukuk National Wildlife Refuge 1988 duck brood survey (draft). USDI, Fish and Wildl. Service, Koyukuk NWR, Galena, AK. 13pp.

Seppi, B. E. 1990. Draft proposal: Waterfowl brood use of wetlands in relation to habitat types. Dept. of Biol. and Wildl., Univ. of Alaska, Fairbanks. 19 pp.

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